Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

SEP 5 1945

932
Ag 82

AIC-252
September, 1949

POWDERED CALCIUM CARBONATE (OYSTER SHELL FLOUR) IN PROCESSING OF SUGARCANE

by Emil K. Ventre and R. T. Balch
U. S. Sugar Plant Field Laboratory 1/
Houma, La.

At the suggestion of the senior author, based on laboratory experiments on clarification of refractory juices, powdered calcium carbonate in the form of oyster shell flour was used in varying quantities by a number of factories during the 1948-9 season. The majority opinion was that this material had definite merit. The few differing opinions, it is believed, arose from an inadequate manner in these cases of using the calcium carbonate, since the urgency of the need for a clarification aid had not permitted preliminary experimentation and checking. Now presented, with the benefit of last season's experience and additional experiments, are specific recommendations on the use of calcium carbonate which should give satisfactory results if correctly followed.

Sources and Description of Calcium Carbonate

Several well-known sources of natural calcium carbonate are limestone, marble, and chalk, but the most readily available yet lesser-known source in Southern Louisiana is the large deposits of oyster and clam shells to be found in near-by Gulf waters. The availability and relatively low cost of ground oyster shells -- oyster shell flour -- led to its selection by the sugar factories last season as a means of aiding clarification. Other forms of calcium carbonate of comparable grade, both natural and chemically prepared, will work equally as well in cane juice clarification.

The degree of fineness is an important consideration in selecting the calcium carbonate product to be used as a clarification aid. The product should be of such fineness that at least 99% passes a 200-mesh screen (wet test). This will insure a minimum of abrasion of pumping equipment without being so fine as to give a carbonate "smoke" to clarified juice. The material used last year was not so finely ground and also contained an appreciable fraction greater than 100-mesh.

Some Basic Principles of Juice Clarification and Observations of Factory Operations

Good clarification is defined from various points of view. From a chemical standpoint it refers to the elimination, by chemical precipitation, of nonsugar constituents obtaining, as a consequence, appreciable increase in juice purity. From a physical standpoint, on which the

1/ One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

factory operator judges the process, good clarification means clear juice, rapid settling of the lime precipitate or muds, low mud levels and "hard" and easily filtering muds which do not overload the filter stations.

Many operators consider slow-settling of the lime precipitate or mud to be the major clarification difficulty. They often overlook the fact that increased mud volumes are of equal or greater importance. It has been found that the lime precipitate settles under gravity to a fairly uniform consistency, but varies with the raw material, within the normal time allotted to settling. Once settled to this point there is very little additional shrinkage in the volume of the muds on further standing. When conditions are such that mud volumes are low, clarification troubles are usually at a minimum. When mud volumes are high, which is normal for several of the present commercial varieties of sugar cane grown for sugar production in Louisiana, and which is accentuated by the processing of old cut cane (through drying out) and trashy cane, a quite difficult situation can occur. High mud volumes mean more volume to be filtered and more muddy filtrate to be returned to the process. The worst conditions arise when this muddy filtrate is returned to raw juice and thence back to the clarifier. It was not unusual last season to find mud volumes, after complete settling, ranging from 35 to 40% of the total volume.

One of the several means of obtaining various degrees of relief from this situation is the use of calcium carbonate in the clarification process.

How Calcium Carbonate Acts in Clarification

When properly applied oyster shell flour acts in three ways. First, it weights the lime floc which causes it to settle faster without increasing the volume of the settling. In fact, the volume may be smaller with use of the carbonate. Second, oyster shell flour is capable of neutralizing free acids. And although under ordinary conditions of clarification, the carbonate has very little opportunity to react, it actually largely prevents the development of any acidity through decomposition. When being used it becomes distributed throughout the clarifier and filter systems and tends to keep these in a "sweeter" condition than would otherwise be so. The carbonate will replace a small portion of the lime used for clarification. Third, if the carbonate is added to the juice as positively charged particles, it neutralizes the negative charge of some of the colloids of cane juice, which causes them to be more easily precipitated.

Proper use of the carbonate thus leads to better clarified juices. These observations form the basis for the following recommendations for use of calcium carbonate as a clarification aid.

Amount of Calcium Carbonate to Use

When clean, fresh cane is being processed, it is not likely that clarification will cause any trouble; however, if stale or trashy cane is being processed, it is advisable to add carbonate continuously at a minimum rate of about 2 pounds per ton. If the condition of the cane appears or is known to be bad, and 2 pounds of the carbonate does not remedy the trouble in clarification, the amount should be increased to a maximum of about 4 pounds per ton. At the rates of 2 and 4 pounds, the cost would range from 0.8 cents to 1.6 cents per ton of cane, at the price of oyster shell flour prevailing in the fall of 1949.

How to Apply the Calcium Carbonate

It is suggested that the calcium carbonate be applied in one of two ways, as follows:

(1) Prepare a mixture of the carbonate and lime in such proportions that when added to juice to give the correct reaction for clarification, the carbonate will be introduced at the rate of about 2 pounds per ton of cane. A convenient and easily prepared mixture is 2 parts by weight of the carbonate (oyster shell flour) to 1 part of lime. Thus, if the lime demand is 1 pound per ton of cane, the rate of carbonate addition will be 2 pounds. The ratio of carbonate to lime can be changed for meeting varying conditions. This mixture of carbonate and lime is suitable for various methods of clarification, such as cold liming, hot liming, or even fractional liming.

(2) The lime and the carbonate may be added as separate suspensions as follows: Prepare the carbonate with lime water or in water along with a small amount of lime. This insures a positive charge on the carbonate particles. Lime should be added first to the juice and followed by the carbonate suspension. This method of application is most conveniently used in fractional - liming clarification. In such a method, cold juice is adjusted to about 6.5 pH with lime, it is then heated, and the carbonate-lime suspension added. Final adjustment is made with either the mixture of carbonate and lime or lime alone to a final reaction of about 7.2 pH cold resulting in a clarified juice of 6.4 - 6.6 pH. Although somewhat complicated, this method is certain to yield excellent clarified juices.

Supplementary

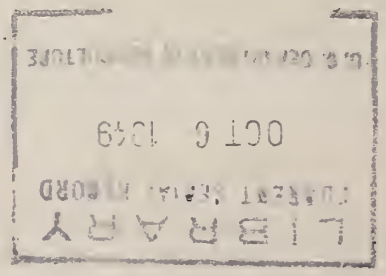
Since oyster shell flour or any other form of calcium carbonate is a material composed of fairly hard particles, it may be expected to have some abrasive action on pumping equipment. But this wear should not be excessive, if the coarse material is eliminated as specified. There will be some tendency for the oyster shell flour to settle out of suspensions, so it will be necessary to provide sufficient agitation at the proper points to prevent this. Also, redesign of some liming devices may be required to handle the mixture of oyster shell flour and lime satisfactorily.

The carbonate of proper fineness does not stop up any of the screens normally used. This applies to juice screens and the filtering screen of the Oliver filter. A deposit sometimes forms on the back of the latter but there is no evidence that this is increased by carbonate. If oyster shell flour is used as outlined, there is little danger of bicarbonate formation which might deposit carboonate scale. No evidence has been presented to indicate that scale formation is any more serious when using oyster shell flour than when not using it. Apparently the scale which is deposited is not a carbonate scale but rather a siliceous type, judging from its reported resistance to acid treatment, and would have occurred in any event where juices containing a high amount of field mud were processed.

Practical Advantage

The practical advantage to be gained through the use of calcium carbonate as a clarification aid is that it permits the clarifiers and filters to operate at nearly normal rated capacity. This means that the mills can grind cane at their normal rate. In turn, this allows the factory to keep abreast of the field operations, as scheduled. By maintaining its grinding rate the mill is automatically furnished a supply of fresh cane with all its attendant advantages.

It must not be taken for granted that oyster shell flour or other forms of calcium carbonate are a cure for all evils. Every effort should be made to correct bad practices, whether in the field or in the factory. Even though the carbonate may serve to expedite the clarification of juices from cane giving high mud volumes and increase yields due to fresher cane, it will not alleviate the reduced yields due to grinding improperly topped cane.



JC - 9/15/49